

REMARKS

This application has been reviewed in light of the final Office Action dated May 3, 2005. In view of the foregoing amendments and the following remarks, favorable reconsideration and withdrawal of the rejections set forth in the Office Action are respectfully requested.

Claims 73-75 and 77-85 are pending. Claims 73, 83 and 84 have been amended. Support for the claim changes can be found in the original disclosure, and therefore no new matter has been added. Claims 73, 83 and 84 are in independent form.

Paragraph 3 of the Office Action states “The reference(s) cited on the PTO-1449 attached herein were fully considered by the examiner and are now made of record as these were references cited in the Information Disclosure Statements filed on 1/18/02 and 10/31/02.” Applicants understand that the Examiner intended to state “The references cited on the Notice of References Cited (PTO-892) attached hereto were fully considered by the Examiner and are now made of record as these were references cited in the Information Disclosure Statements filed on 1/18/02 and 10/31/01.” (It is noted that no Form PTO-1449 was enclosed with the Office Action.)

Claims 73, 74, 77-81 and 83-85 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Nos. 5,500,988 (*Moynihan et al.*) and 5,719,417 (*Roeder et al.*), and the article entitled “Growth and Characterization of . . . Single Crystal Piezoelectrics” (*Farrey et al.*). Claim 75 was rejected under 35 U.S.C. § 103(a) as being unpatentable over *Moynihan et al.*, *Roeder et al.*, *Farrey et al.* and further in view of European Patent Application Publication No. 0 930 165 (*EP '165*). Claim 82 was rejected under 35 U.S.C. §

103(a) as being unpatentable over *Moynihan et al.*, *Roeder et al.*, *Farrey et al.* and further in view of U.S. Patent No. 5,453,262 (*Dawson et al.*). In response, while not conceding the propriety of the rejections, independent Claims 73, 83 and 84 have been amended. Applicants submit that, as amended, these claims are allowable for at least the following reasons.

Independent Claim 73 recites, *inter alia*, a step of forming by a vapor method on a supporting substrate a first layer having a perovskite structure, a temperature at a time of formation of the first layer being at least 500°C during the vapor method, and a step of subsequently cooling from the formation temperature at least to 450°C with a cooling speed of at least 30°C/minute. Each of independent Claims 83 and 84 includes similar recitations.

None of the cited documents is understood to teach a step of forming such a layer by a vapor method on a substrate at such a temperature, followed by such a cooling step.

Moynihan et al. teaches applying a series of PZT layers 3 to an electroded substrate 10 by a sol gel process, then annealing by heating to 600° C to 800° C, and then cooling to room temperature in about 30 seconds. See col. 3, lines 19-39. However, nothing in *Moynihan et al.* would teach or suggest a step of forming by a vapor method on a substrate a first layer having a perovskite structure at a temperature at least 500°C, followed by a step of cooling from the formation temperature at least to 450°C with a cooling speed of at least 30°C/minute.

Roeder et al. teaches depositing a layer of PLT and then a layer of PZT, using a vapor method, the process being carried out at temperatures between 525°-550° C. See, e.g., col. 7, lines 12-36. However, nothing in *Roeder et al.* would teach or suggest a step of forming by a vapor method on a substrate a first layer having a perovskite structure at a

temperature at least 500°C, followed by a step of cooling from the formation temperature at least to 450°C with a cooling speed of at least 30°C/minute.

Thus, neither *Moynihan et al.* nor *Roeder et al.* contains all of the elements of any of the independent claims. For at least this reason, those claims are believed allowable over the cited art. (While *Farrey et al.* was cited in the rejection of the independent claims, it is noted that that reference was not in fact applied against those claims.)

In regard to the combining of *Roeder et al.* with *Moynihan et al.*, Applicants understand that the Examiner cites “control[ling] the orientation of the layers of the piezoelectric element” as the motivation for such combination (see pages 4-5 of the Office Action). However, Applicants submit that (1) the cited motivation is not valid, and (2) the combination of the two references is not proper.

(1) As noted by *Roeder et al.*, in the seed layer (PLT), orientation of the crystal lattice structure is determined by the ratio of lead plus lanthanum (A-sites) to titanium (B-sites). See *Roeder et al.*, col. 2, line 62-63, and col. 3, lines 26-34. The orientation of the crystal lattice structure of the seed layer (PLT), in turn, determines the orientation of the crystal lattice structure of the ferroelectric PZT layer. See *Roeder et al.*, col. 3, lines 34-36. However, according to the invention of *Moynihan et al.*, there is no such seed layer. Rather, according to *Moynihan et al.*’s invention, a PZT perovskite film 18 made of multiple layers 3 of PZT material is formed on an electroded substrate. See *Moynihan et al.*, e.g., col. 3, line 64 - col. 4, line 48. But such a PZT layer cannot serve as a seed layer for, as explained by *Roeder et al.*, the crystal orientation of a PZT layer is not determined by the A-site/ B-site ratio. See *Roeder et al.*, col. 2, line 62-63. Nothing in *Moynihan et al.*’s invention is understood to be

capable of serving as a seed layer such as is required by *Roeder et al.*'s invention.

Accordingly, it is understood that merely incorporating *Roeder et al.*'s vapor method of formation into *Moynihan et al.*'s invention would not result in a combination that achieves "control [of] the orientation of the layers of the piezoelectric element," the purported motivation cited by the Examiner. Thus, the alleged motivation for combining the cited references is not seen to be valid.

If, to validate the motivation, *Roeder et al.*'s seed layer were incorporated into *Moynihan et al.*'s invention, it is understood that the cited art could be rendered unsatisfactory for its intended purpose and/or the principle of its operation could be changed.

In addition, nothing is seen in *Moynihan et al.* to indicate that the orientation control sought by *Roeder et al.* is required or desired for *Moynihan et al.*'s invention. Thus, no evidence is seen that would indicate that the motivation to combine alleged in the Office Action is in fact valid.

(2) *Roeder et al.* identifies a prior art method to control orientation of the crystal lattice structure of ferroelectric thin films by utilizing substrate materials with a coefficient of thermal expansion (CTE) mismatched to that of the ferroelectric film. A problem with this method, in view of the use of silicon as a material of choice for a substrate, is that the film may be formed with a highly undesirable [100] orientation upon cooling. Corresponding CTE issues arise for other substrate materials. See *Roeder et al.*, col. 2, lines 6-31. Accordingly, *Roeder et al.* provides an alternative method to control crystal orientation in ferroelectric thin films that has advantages and is not understood to involve the cooling that can have adverse side effects.

Accordingly, it is understood that the cooling provided by *Moynihan et al.* is not contemplated by *Roeder et al.* and may not be suitable for being combined with the method of *Roeder et al.* Thus, it is understood that combining *Roeder et al.* with *Moynihan et al.* may result in rendering the cited art unsatisfactory for its intended purpose and/or may change the principle of operation of the cited art. Therefore, the proposed combination of *Roeder et al.* with *Moynihan et al.* is not understood to be proper.

Since the combination of *Roeder et al.* with *Moynihan et al.* is not seen to be proper, and the motivation to combine is not seen to be valid, the independent claims are believed allowable over the cited art for at least these reasons as well.

A review of the other art of record, including *Farrey et al.*, EP '165 and *Dawson et al.*, has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for at least the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

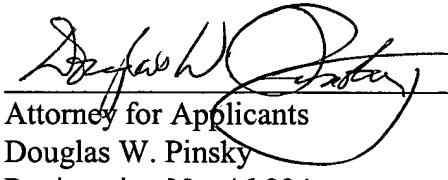
Applicants submit that this Amendment After Final Rejection clearly places the subject application in condition for allowance. This Amendment was not presented earlier, because Applicants believed that the prior Amendment placed the subject application in

condition for allowance. Accordingly, entry of the instant Amendment, as an earnest attempt to advance prosecution and reduce the number of issues, is requested under 37 C.F.R. § 1.116.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our Washington, D.C. Office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,



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